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MANUAL OF INSTRUCTIONS FOR PROJECTING EMISSIONS
IN SMALL GEOGRAPHIC AREAS - PRELIMINARY TEST
USING BALTIMORE AQMA DATA

Booz-Allen and Hamilton, Incorporated

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16. ABSTRACT This Manual provides guidance and direction for developing and improving a comprehensive emission inventory and for projecting future emissions at the county level. It is divided into four chapters: Chapter I: contains background information on emission source categories and forecast techniques and an introduction to the content of the Manual Chapter II: presents a summary of the data sources referenced in the Manual Chapter III: contains specific procedures, data sources and tabulating formats for updating or creating a point and area source emission inventory Chapter IV: contains specific procedures, data sources and tabulating formats for developing growth factors to project present activity and emissions into the future.		
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by

**Booz-Allen & Hamilton Inc.
4733 Bethesda Avenue
Bethesda, Maryland 20014**

Contract No. 68-02-1005

EPA Project Officer: John Bosch

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I. INTRODUCTION

1. PURPOSE OF THE PRELIMINARY TEST

This report summarizes the results obtained from a field test of the procedures for estimating present and future air pollution emissions contained in "A Manual of Instructions for Projecting Emissions in Small Geographic Areas." The field test was conducted with data obtained from the Baltimore, Maryland Air Quality Maintenance Area (AQMA). There were two purposes for this test:

- . To assess the feasibility of procedures given in the initial version of the Manual
- . To establish alternative procedures found to be more directly applicable than those initially established, based on working with Baltimore data.

The discussion and results presented in this report constitute the final output of the field test itself. The revisions of the Manual which were identified as a result of this test have been incorporated in a revised version published on December 12, 1974. This Manual is to become Volume 7, "Projecting County Emissions" of the "Guidelines for Air Quality Planning and Analysis," OAQPS Guideline 1.2-026. The field test results conform to the structure of the Manual as revised.

The Manual provides guidance and direction for developing and improving a comprehensive emission inventory and for projecting future emissions at the county level. It is divided into four chapters:

- . Chapter I: contains background information on emission source categories and forecast techniques and an introduction to the content of the Manual
- . Chapter II: presents a summary of the data sources referenced in the Manual
- . Chapter III: contains specific procedures, data sources and tabulating formats for updating or creating a point and area source emission inventory

Chapter IV: contains specific procedures, data sources and tabulating formats for developing growth factors to project present activity and emissions into the future.

The projection methods and sources proposed in the Manual are not the only valid ones that may be used; they are presented to illustrate both the type of data that must be identified and the general approach to be used in forecasting future activity, and to identify all the elements that must be considered in projecting a complete and accurate emission inventory.

The goal of the program was to test the Manual procedures and not to project emissions for the Baltimore AQMA. Consequently, the accuracy of the emission projections developed is certainly less than the maximum achievable using the procedures recommended in the Manual, or any alternate projection methodology, and the results presented in this report should not be interpreted as the final emissions inventory and projections for the Baltimore AQMA.

This report documents the data sources consulted, the procedures actually followed including deviations from specific Manual instructions, and the numerical results of the projection effort. Detailed familiarity with the organization and content of the Manual is assumed throughout. It is recommended that the results of this test be studied before attempting to implement the emission projection procedures given in the Manual. While this report will not provide a solution for every specific problem that may arise, it nevertheless provides informative guidance concerning the general manner of forecasting future activity and air pollution and illustrates how the procedures in the Manual are to be applied.

2. SCOPE

The Manual which was tested in this program is a guideline and not an inflexible set of instructions. Consequently the basis for an evaluation of the Manual must be the relevance and accuracy of its information, and how successfully that information is communicated to the reader. The field test involved using actual emission and projection data from the Baltimore, Maryland AQMA to evaluate the applicability of the instructions given in the Manual. The scope of the program did not include a technical evaluation of the projection methodology to recommend more accurate projection techniques. Furthermore,

the resource constraints of the program were such that not every procedure given in the Manual could be tested, including the extensive interview program recommended as the most accurate method to develop emission forecasts. Also, not every source document and local planning reference recommended in the Manual could be consulted within the time and resources available for this test.

Emissions and projection data for the Baltimore AQMA were used to test the clarity of selected procedures and suggested formats for tabulating results. The Baltimore AQMA coincides with the Baltimore Standard Metropolitan Statistical Area (SMSA) and the Baltimore Air Quality Region (AQCR). It is comprised of Baltimore City and five surrounding counties: Anne Arundel, Carroll, Harford, Howard, and Baltimore County. The specific emission and projection data used are described in detail in Section 3 of this chapter.

The Manual contains instructions for updating and upgrading a point and area source emission inventory. Instructions are also given for organizing the data into a format suitable for submission to the EPA National Emissions Data System (NEDS). These procedures were reviewed in detail for clarity, but little effort was expended in collecting emissions data for Baltimore because the Maryland Bureau of Air Quality Control (BAQC) maintains a comprehensive and up-to-date emission inventory for the state. Accurate emissions data for the AQMA are available from this inventory. The data contained in the Maryland Emission Inventory (MEI) has been coded and submitted to EPA, and following verification and correction, it will be included in the NEDS inventory. Hence the MEI was considered to represent adequate baseline data.

The exercise of the inventory update procedures of Chapter III in the Manual was limited to conversion of the MEI data into the uniform data formats required for completing the projections. These data formats are identical with a standard output format of the NEDS system, the National Emission Report (NER). The data in the MEI are considered to represent the state's emission inventory during calendar year 1974; therefore, 1974 was selected as the base year upon which the emission projections were based.

Procedures for projecting emissions are contained in Chapter IV of the Manual. It would clearly be desirable to test all three levels of projection instructions given in this chapter both to establish the validity of all the procedures and to project outputs from the three levels in

order to indicate the magnitude of the potential errors in the less accurate projection methodologies. Such a comprehensive test was not attempted for a number of reasons. In general, Level 3 procedures could not be followed because they involve an extensive and time-consuming interview program to determine growth forecasts for individual plants and point sources. Contacting individuals at large number of major polluting plants would have exceeded the resources of the test and would have involved obtaining legal authority to conduct the interviews under the auspices of the Maryland Bureau of Air Quality Control. Consequently, the test was concerned with Level 1 and Level 2 procedures only.

The projection methodology for Level 1 and Level 2 requires the determination of growth factors representing the expected change in pollution producing activity for aggregated emission source categories. Level 1 and Level 2 differ primarily in the recommended sources for growth forecasts. Level 1 projections usually require data published by state or federal agencies, while Level 2 projections ordinarily rely on data available in local planning documents. The type, extent and format of data in industrial, transportation and land use plans for the Baltimore area would be unique to Baltimore and its air pollution problems and industry mix. Focusing a substantial amount of effort on reviewing such plans would benefit the air quality maintenance effort in Baltimore but would not contribute significantly to testing and evaluating the projection procedures. The data sources actually consulted, therefore, were usually a mix of Level 1 and Level 2 sources, and the choice of sources was based on their availability and their direct applicability. In this way maximum resources could be devoted to determining whether the Manual instructions and tabulating formats were understandable and could be readily completed by the user, and whether the instructions as given provided a comprehensive treatment of all major emission source categories.

Emissions were projected to 1980. If economic or demographic forecast data were not available for 1980, linear interpolation was used to obtain the necessary information. Since the base year inventory upon which the projections are based is 1974, all growth factors were computed for the six-year period (1974-1980).

3. DATA SOURCES

The emissions inventory used as a basis for the emission projections was the Maryland Emission Inventory (MEI), as noted earlier. Since Chapter III of the Manual is concerned with accumulating data in the NEDS data format and the Chapter IV projections are based on data organized and classified in that format, it would have been more straightforward to test the Manual procedures using the NEDS emission inventory for Baltimore. Unfortunately the Baltimore data currently in the NEDS system are out of date, and the more accurate data in the MEI have not yet been completely incorporated into NEDS. For this reason the MEI inventory was used for this project.

Four standard MEI printout formats were consulted. These were the:

- . Summary of Emissions by Premise
- . Inventory of Processing and Manufacturing Equipment by Premise
- . Inventory of Incinerators by Premise
- . Inventory of Fuel Burners by Premise.

The first printout contains summary data for each premise within a county, giving the total fuel consumption, solid waste disposal, and net incineration, fuel and process emissions for each point source emitting more than 25 tons per year of any pollutant. The second and third printouts contain data for industrial process and incineration point sources classified by county, and by premise identification numbers within a county. The fourth printout contains data for fuel burning sources classified by county, by fuel burned within each county, and by premise identification numbers within each fuel category. Sample MEI data formats are given in Figure I-1 through Figure I-4.

The MEI inventory, which is represented in its entirety by the last three printouts, contains data for each industrial, commercial and institutional source emitting more than 1 pound per day of any criteria pollutant. In comparison, a point source in the NEDS system is defined as a source emitting more than 100 tons per year of any criteria pollutant. Thus the MEI inventory contains information on many more point sources than are required for NEDS.

DATE 08/03/74

AIR QUALITY CONTROL SURVEY

PATIENCE GEORGE COUNTY

MAJOR SOURCES 25+ TONS/YR

TYPE EQUIPMENT	ANNUAL REFUSE 1000 #	COAL TONS	OIL 4-6 M GALS	OIL 1+2 M GALS	NAT GAS MM FT	LP GAS M GALS	PART	ANNUAL EMISSIONS 1000 #	SOX	NOX	CARB	HC
PROCESSING FUEL-BURNING INCINERATORS	5246		6510	273			46 51		667 5	577 7	128	476 25 5
COMPANY	ANDREWS AF BASE				PREMISE 00655	TOTALS	47		872	584	128	506

TYPE EQUIPMENT	ANNUAL REFUSE 1000 #	COAL TONS	OIL 4-6 M GALS	OIL 1+2 M GALS	NAT GAS MM FT	LP GAS M GALS	PART	ANNUAL EMISSIONS 1000 #	SOX	NOX	CARB	HC
PROCESSING FUEL-BURNING INCINERATORS	21		1762	635			50		254	197		7
COMPANY	AGRICULTURAL RESEARCH CENTER				PREMISE 00667	TOTALS	50		254	197		7

TYPE EQUIPMENT	ANNUAL REFUSE 1000 #	COAL TONS	OIL 4-6 M GALS	OIL 1+2 M GALS	NAT GAS MM FT	LP GAS M GALS	PART	ANNUAL EMISSIONS 1000 #	SOX	NOX	CARB	HC
PROCESSING FUEL-BURNING INCINERATORS				1500	400		30		66	140		7
COMPANY	GODDARD SPACE FLT. CENTER				PREMISE 00675	TOTALS	30		66	140		7

TYPE EQUIPMENT	ANNUAL REFUSE 1000 #	COAL TONS	OIL 4-6 M GALS	OIL 1+2 M GALS	NAT GAS MM FT	LP GAS M GALS	PART	ANNUAL EMISSIONS 1000 #	SOX	NOX	CARB	HC
PROCESSING FUEL-BURNING INCINERATORS				233	271		8		13	107		21
COMPANY	LANDOVER MALL				PREMISE 00677	TOTALS	6		13	107		21

Figure I-1. Sample Maryland Emission Inventory Format, Summary of Emissions by Premise

00103174

Figure I-2. Sample Maryland Emission Inventory Format, Inventory of Processing and Manufacturing Equipment by Premise

AIR QUALITY CONTROL SUMMARY																	BALTIMORE CO.				
SUMMARY OF INCINERATORS										BY PREMISE							DAILY EMISSIONS - LBS				
TYPE OF PREMISE	EQUIPMENT	T. NUMBER	YR. REG. UNITS	TYPE	STACK HT. FT.	CAP.	PREMISE NO.	00039	WASTE	FEED	NO. YR.	REFUSE	AUX. BURN	COORDINATES	0906-568	STACK EM. CNT	PART	NOX	CO	SOX	HC
GREATER BALTIMORE MEDICAL CENTER	HOSP.	1	00108	69	R	1	058	1	AAP	D	7	YES	COORDINATES	0906-568	NG	SC, SAR					
ST. JOSEPH HOSPITAL	HOSP.	1	00159	65	E	1	190	6	AAP	D	2	YES	COORDINATES	0906-568	NG	SC					
MONTGOMERY WARD 221 E. JUPPA RD.	STORES	2	00105	71	N	1	044	7	TR	D	1404	YES	COORDINATES	0917-498	NG	SC, SAR	1	5	23	2	1
SISTERS OF N.O.-VILLA MARIA	APTS.	1	00174	73	N	1	065	1	OTH	D	21	YES	COORDINATES	0942-591	LP	SC	1				
DRUG FAIR-PADONIA	STORES	1	00029	00	N	1	030	2	TR	C	167	NO	COORDINATES	0905-532	NG	DIS	1	1	11	1	
ROSEWOOD STATE HOSP.	HOSP.	1	00182	74	N	1	040	1	AAP	D	36	YES	COORDINATES	0864-578	NG	DIS	1				
MILFORD MANOR NURSING HOME	APTS.	1	00098	67	E	1	024	1	TR	D		YES	COORDINATES	0878-558	NG	N					
H. S. CROCKER CO.	STORES	2	00204	00	N	1	020	4	TR	C	76	YES	COORDINATES	0938-535	NG	DIS	1				
HOUSE OF THE GOOD SHEPHERD	APTS.	2	00056	00	N	1	020	2	TR	D	187	YES	COORDINATES	0890-512	NG	SC	1	1	3		
MARYLAND SPECIALTY WIRE MFG.	HOSP.	2	00058	69	N	1	018	6	TR	D	260	NO	COORDINATES	0900-603	NG	DIS	1	1			
FRANKLIN SQUARE HOSPITAL	HOSP.	1	00176	73	N	1	070	2	OTH	D	72	YES	COORDINATES	0947-553	NG	N					
FORT HOWARD VET. ADMIN. HOSP.	HOSP.	2	00072	69	E	1	039	15	P20G	C	3094	YES	COORDINATES	0957-498	NG	SC, SAR	13	5	42	4	
HOSP.	HOSP.	2	00214	72	N	1	032	3	AAP	D	76	YES	COORDINATES	0853-585	NG	DIS	1				
HUMANE SOCIETY-BALTIMORE COUNTY	OTHER	2	00077	65	E	1	030	6	AAP	D	1092	YES	COORDINATES	0875-524	OI	SC	5	3	15	1	
ST. JOSEPH'S HOME	APTS.	1	00107	63	E	1	030	2	TR	D	31	NO	COORDINATES	0875-524	NG	N	1				
GLASSIPS, INC.	MFG.	2	00102	69	E	1	026	6	TR	D	520	NO	COORDINATES	0912-570	N	DIS	4	1	10	1	
NELSON CO.	MFG.	2	00200	00	+	1	040	25	TPW	D	9360	YES	COORDINATES	0952-510	NG	DIS	4	3	13	1	

Figure I-3. Sample Maryland Emission Inventory Format, Inventory of Incinerators by Premise

ANNE ARCADE

Inventory of Fuel Burners by Premise

Since the procedures in the Manual are based specifically on NEDS format data, there were some areas in which the MEI data were incomplete or not directly useable. The EPA Source Classification Code (SCC) is not given for each source, although the four-digit SIC and the three-digit HEW equipment codes are given.* Since the classification scheme given in the Manual for process emissions and estimated future emission control is based on the SCC code, it is not possible within the scope of the test to determine accurate relationships between MEI emission data and the emission source categories given in the Manual. In addition, the estimated or measured control efficiency for each point source is not given. Only a written description of the type of control equipment, from which it is impossible to estimate numerically the control efficiency is given on the MEI printout. Also allowable emissions and compliance status and schedules are not given. Source specific data concerning control efficiency, allowable emissions and compliance with existing regulations, in addition to expected growth, are required to estimate future emissions accurately. Because of the deficiencies in the MEI data noted above, it was not possible to include controls in estimating future emissions levels and the results are defective in this regard. Finally, it should be noted that the MEI carbon monoxide emission data are certainly incomplete because existing air quality and emission inventory data indicate that future CO levels in the AQMA are not expected to exceed air quality standards. Because of all of these data format differences between the MEI and NEDS, some of the procedures in the Manual were modified to complete the emission projections; these modifications are described in the text narrative.

Chapter II of the Manual contains a summary of recommended sources of data required to the inventory update and emission projections. The sources actually used in this test are cited in the narrative and are summarized at the end of this chapter.

*

The HEW coding system is given in Air Pollution Manual of Coding, U. S. Department of Health, Education and Welfare, 1968.

4. STRUCTURE OF THE TEST NARRATIVE

The following chapter contains documentation of all the procedures used in field testing the Manual using Baltimore data as well as a presentation of the numerical results obtained. The chapter begins with a preliminary analysis of the data and the calculation of general economic and demographic growth factors as recommended in the Manual. This is followed by six sections, each dealing with inventory update and emission projection for the following source categories:

- . Industrial process
- . Fuel combustion
- . Transportation
- . Electric generation
- . Incineration
- . Miscellaneous area sources.

This format follows that given in the Manual. Each source category section contains complete documentation of all calculations and data sources for both the inventory update and emission projections followed by completed tables and worksheets. The tables were taken directly from the Manual and completed according to the instructions. Tables pertinent to sections of the Manual not tested have been omitted. Worksheets providing additional documentation not called for specifically in the Manual have been included, however.

5. GLOSSARY OF TERMS

The definition of terms and acronyms used in the Manual and the test narrative are given below:

- . AP-42: EPA document, Compilation of Air Pollutant Emission Factors,
- . APTD-1135: EPA document, Guide for Compiling a Comprehensive Emission Inventory
- . AQCR: Air Quality Control Region
- . AQMA: Air Quality Maintenance Area
- . AQMP: Air Quality Maintenance Plan

- . BAQC: Maryland Bureau of Air Quality Control
- . BMATS: Baltimore Metropolitan Area Transportation Study
- . BRPC: Baltimore Regional Planning Council
- . CBP: County Business Patterns, U.S. Department of Commerce
- . CO: Carbon monoxide
- . County shares: county portion of an activity level which is defined or measured only at the state level
- . DD: heating degree days, available from a number of sources, including Climatic Atlas of the U.S., U.S. Climatological Reports, U.S. Weather Bureau, or Journal of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- . Emission factor: factor relating activity levels to net emissions for area sources, and to uncontrolled emission for point sources
- . Equivalent control efficiency: effect of most stringent applicable control regulations, expressed in terms equivalent to control efficiency
- . Growth factor: dimensionless ratio of projected activity to baseline activity
- . HC: hydrocarbon. (This term ordinarily indicates total hydrocarbons. If only reactive hydrocarbons or non-methane hydrocarbons are of interest, "reactive HC" or "non-methane HC" may be substituted for "HC" in the manual: this fact should be noted on all documentation and completed tables.)
- . HC (evap): evaporative hydrocarbon
- . HC (exh): exhaust hydrocarbon
- . HDD: heavy-duty diesel vehicle
- . HDV: heavy-duty gasoline vehicle

HEW Code: three-digit equipment coding system given in Air Pollution Manual of Coding, U.S. Department of Health Education and Welfare (1968)

h. u. : housing unit

LDT: light-duty truck (gasoline)

LDV: light-duty gasoline vehicle

Level: three levels of effort are given for the calculations, referring to the level of detail specified and expected accuracy

MC: motorcycle

MEI: Maryland Emission Inventory

LTO: landing-takeoff cycle

MIS: Mineral Industry Surveys, U.S. Department of the Interior

mpg: miles per gallon

NEDS: National Emissions Data System

NER: National Emission Report

NO_x or NOX: nitrogen oxides

NSPS: Federal New Source Performance Standards

OBERS Projections: economic projections developed by the U.S. Departments of Commerce and Agriculture

PART: particulates

Point source: MEI definition: 1 pound per day
NEDS definition: 100 tons per year

SCC: eight-digit EPA source classification code (e. g. , 3-01-001-01, adipic acid production, general cyclohex process)

- . SIC: Standard Industrial Classification
- . SMSA: standard metropolitan statistical area
- . SO_x or SOX: sulfur oxides
- . TPY: tons per year
- . VMT: vehicle-miles travelled

II. DISCUSSION OF PRELIMINARY TEST RESULTS

All air pollution emissions for any geographic region may be classified and summarized into the emission source categories specified in Tables 7.1 and 7.2 of the Manual. For any given region, some categories may account for most of the emissions while others produce little or no emissions. In addition, some of the point and area source emissions in the region may be concentrated in one county or small section of the region, not distributed over the entire area. Estimating present or projected emissions in an accurate but efficient manner requires allocating the appropriate effort and resources to each emission source category. The most time consuming but accurate calculations and data searches should be conducted for the major emission sources, with proportionally less effort directed to minor or negligible sources. This general approach was followed during the test of the Manual.

In order to identify the major emission source categories in the Baltimore AQMA, the general pattern of air pollution emissions in the AQMA was determined from data contained in the trial Air Quality Maintenance Plan (AQMP).⁽¹⁾ (Superscripts refer to references given at the end of the report.) Another source for this type of information is the NEDS county emission inventory summary in the National Emission Report (NER) format, which contains emission data aggregated in the same format as Tables 7.1 and 7.2 of the Manual. The analysis of emission data led to the following conclusions:

- . Approximately 55 percent of the point source particulate emissions in the AQMA are the product of industrial processes, and two thirds of these process emissions originate in Baltimore County alone
- . Emissions from solid waste disposal are limited to incineration in Baltimore City
- . More than 90% of emissions of sulfur oxides come from stationary fuel combustion and industrial process sources located in Anne Arundel and Baltimore counties and Baltimore City, and almost 50% of the SO_x emissions are due to power plants alone

More than ninety percent of the hydrocarbon emissions from highway vehicles and other transportation sources occurs in the Baltimore Metropolitan Area Transportation Study (BMATS) region, which is composed of Baltimore City and portions of Anne Arundel, Howard and Baltimore counties.

It is important to determine the pattern of emissions if detailed emission data and projections for a specific pollutant are required. For example, if levels of particulate or SO_x emissions are critical, the analysis should focus on stationary combustion and industrial process sources in the areas mentioned above. If transportation hydrocarbon emissions in the AQMA are critical, the analysis should focus on data related to the BMATS program, even though the BMATS area is much smaller geographically than the entire AQMA.

* * * * *

The Manual suggests that a number of growth factors be computed before beginning the projections for any of the specific source categories since they are referenced a number of times in the projections, and because they can be used for comparison with growth factors for the same activities developed from local data. These growth factors include a population growth factor to be computed from the best available local population projections as well as economic growth factors which should be computed from the OBERS projection data published by the U. S. Department of Commerce. (2, 3) For this test, the appropriate growth factors were computed as follows:

Population: The 1970 AQMA population was determined from 1970 Census data by county. (4) AQMA population projections for 1980 were developed by the Baltimore Regional Planning Council (BRPC). (5) The population growth over the ten year period is expected to be 17.1 percent. If it is assumed that the annual growth rate will remain constant during that period, the annual growth rate will be 1.59 percent per year. The population growth factor for the six-year period (1974-1980) is therefore 1.10. This is the population growth factor which was used in the test.

Industrial Growth: The OBERS growth factors for the nine major NER process categories in the AQMA and the growth factor for the entire manufacturing sector were computed. Earnings for 1980 were taken from the OBERS projections for SMSAs⁽³⁾ (based on series E population projections). Since these projections contain no data for any years earlier than 1980, the 1975 earnings were taken from OBERS AQCR projections. ⁽²⁾ (The Baltimore AQCR, SMSA and AQMA are coincident.) The correspondence between OBERS sectors and NER process categories given in the Manual was used in computing the data (see footnotes 1, 2 and 3).

NER Process Category	Earnings (millions of 1967 dollars)		6 Year Growth Factor (1974-1980)
	1975	1980	
Chemical Manufacturing	126.8	157.9	1.29
Food/Agriculture	177.2	181.8	1.03
Primary Metals	450.2	445.3	0.99
Mineral Products ¹	166	197.6	1.23
Petroleum	8.5	11.4	1.41
Wood Products ²	105	124.3	1.22
Evaporation ³	1957	2086	1.08
Metal Fabrication	228.5	235	1.03
Other Manufacturing	166	197.6	1.23
Total Manufacturing	1957	2086	1.08

¹ Earnings for "Other Manufacturing" sector

² Earnings for "Lumber Products and Furniture" and "Paper and Allied Products" sectors

³ Earnings for "Total Manufacturing"

The six-year growth factor for total manufacturing (1.08) indicates a forecast of relatively slow growth. This growth rate is slightly greater than historic growth as determined from data published for the period 1967-1972 by BRPC⁽⁵⁻⁸⁾ which indicate an equivalent six-year growth factor of 1.05. This is based on an increase in value added by the manufacturing sector of 20.8 percent, and a wholesale price increase of 17 percent over the same period due to inflation. The real increase in value added during this period (in constant dollars) was only 3.8 percent, which is equivalent to a yearly increase of 0.75 percent.

Commercial/Institutional Employment: Employment forecasts published by BRPC⁽⁵⁻⁸⁾ are as follows:

<u>Category</u>	<u>SIC</u>	<u>Employment (000)</u>	
		<u>1970</u>	<u>1980</u>
Retail	52-59	141.7	161.0
Finance, Insurance, Real Estate	60-67	44.9	53.0
Service	70-79, 81, 88, 89	88.7	108.0
Government Institution	80, 82, 86, 91-93	261.8	310.0
Extensive Industry (including transportation)	1-17, 40-50	159.6	177.0
Manufacturing	19-39	204.2	210.0

In the absence of more detailed data the commercial/institutional sector was assumed to be composed of the first five categories (all groups except manufacturing). The increase in commercial/institutional employment over the ten year period is expected to be 16.1 percent. This is equivalent to a growth rate of 1.5 percent per year, or a growth factor of 1.094 for the six year period.

- . Agricultural Activity: Projected earnings for the OBERS agriculture sector for 1975 and 1980 are \$31 million and \$39.7 million respectively (1967 dollars) and can be found in the same sources^(2,3) cited previously. From this data a six-year growth factor of 1.33 was computed.
- . Transportation Sector Growth: Earnings data for the transportation sector were taken from the OBERS projections^(2,3) referenced previously. Projected earnings for 1980 and actual earnings for 1970 are \$668.4 million and \$508.1 million respectively (1967 dollars). This yields a six-year growth factor of 1.19.

Results of the preliminary test classified by emission source category are presented and discussed in six sections as follows:

- . Industrial Process
- . Fuel Combustion
- . Transportation
- . Electric Generation
- . Incineration
- . Miscellaneous Area Sources

The structure of the presentation is keyed directly to the format given in the Manual. In reviewing these results it is useful to refer to the appropriate sections of the Manual in parallel.

1. INDUSTRIAL PROCESS

This section contains the test results for the procedures to determine present and future industrial process emissions.

(1) Inventory Update

Summary: Net emissions for each individual point source and for each facility were available from the MEI; these data were sorted and accumulated in the NEDS process category format.

Approach: Base year emissions were taken from the MEI Summary of Emissions by Premise, which gives aggregated process emissions for each facility or plant in the AQMA. The company's name and its principal product were interpreted to assign all the emissions for the facility to one NEDS process category. These emissions were entered in columns 7-11, Table 1.1. Since there is no emission-producing activity for the leather and textile industries in the AQMA, those lines were left blank. At the aggregated level of this MEI printout, secondary metals industries could not be differentiated from primary metals, therefore all such activity was included in the primary metals category. In addition, all emissions from inprocess fuel combustion at each facility are included in the emissions in the single NEDS process category for that facility, thus the inprocess fuel category was also left blank. If NEDS emission inventory data were used, emissions for these categories could be easily determined from the SCC code. The two-digit SIC codes for each process category are shown on the left side of Table 1.1.

A more accurate but time consuming approach for aggregating MEI data into NER process categories would be to assign the emissions for each point source to a specific NER process category and then add up all point source data to produce totals for each process category. This approach is more accurate because all the emission-producing activities at a given facility are not necessarily limited to one NER process category. However, to use this method it would be necessary to determine the appropriate NER category based on the four digit SIC code and three digit HEW equipment code, because point sources in the MEI are not categorized by SCC code.

(2) Emission Projections

Summary: The general procedure used to project emissions was first to develop growth factors for each NER process category and then to use these factors to project net base year emissions to net emissions for the projection year. This method is essentially equivalent to that of Level 1, Method 1, with the exception of the procedure for including future emission control regulations. This point is discussed in detail below.

Approach: The instructions for Method 1 of Level 1, in addition to developing process category growth factors, require computing weighted emission-control factors which reflect the change in required emission control for each source category between the base year and the projection year. In this test, it was not possible to include controls since current emission control efficiency is not reported for each source in the MEI. The MEI data includes only a written description of the general type of emission control, if any, and not the actual control efficiency. Thus even a qualitative estimate of the extent of the emission control in the base year could not be determined. Consequently, the space in Table 1.1 for control factor data (columns 13-17) was left blank. In effect the results of the test describe future emissions subject to controls currently in place.

The growth factors used for each process category were those computed earlier in this chapter from the OBERS projections. These growth factors were entered in column 12, Table 1.1. Net baseline emissions were multiplied by the growth factor to produce 1980 emissions and were entered in Table 7.2.

Conclusions: The most accurate method for forecasting process emissions, as described in the Level 3 procedures, involves forecasting on an individual point source basis rather than on an aggregated source basis. This is because source-specific data on base year emission control, equipment age and operating capacity are needed to determine the equivalent source activity level and projected net emissions as affected by future emission control requirements. Individual source calculations for Baltimore would be greatly assisted by using automatic data processing programs accessing the existing computerized source inventories, rather than using hand calculations only. Such an effort was, however, well outside the scope of this preliminary test.

The effect of future emission controls was not included in the projections because base year emission control efficiency is not reported by the MEI. More stringent regulations to become effective before 1980 will presumably cause a reduction in process emissions, so the emission projections developed in this section probably overestimate the levels which should reasonably be expected.

2. FUEL COMBUSTION

This section contains the test results for the procedures to determine present and future emissions from all stationary fuel combustion sources except electric generation which is considered in Section 4.

(1) Inventory Update

Summary: Current fuel use data were available from the MEI; these data were sorted and accumulated to conform to the NEDS fuel data format as given in Table 2.1.

Approach: The MEI Fuel Combustion inventory gives the total nonresidential fuel use for bituminous coal, distillate oil, residual oil and natural gas for each county (including point and area sources). While small quantities of minor fuels are burned in the AQMA, their contribution to total fuel combustion emissions is insignificant and consequently these minor fuels have not been included in the calculations. In addition, differentiation between fuel use for external and internal combustion is not given in the MEI, so all fuel data was entered in the external combustion columns of Table 2.1. The summation of point source fuel use for each industrial, commercial/institutional and power generation facility is available from the MEI Summary of Emissions by Premise. Data for each facility were summed to give point source fuel use in the county for these three customer categories. Industrial and commercial/institutional fuel data were used in this section; fuel data for electric generation was used in Section 4. For each county, area source fuel use for each fuel was computed as the difference between total fuel use and point-source fuel use. County totals for point-source industrial, point source commercial/institutional, and area source fuel use were added to give AQMA totals. Area-source fuel use was then allocated to industrial and commercial/institutional sources by using the point-source proportions. These data were entered in Table 2.1. Residential (area source) fuel use, since it is not included in the MEI inventory, was taken from additional emissions and fuel data supplied by BAQC ⁽⁹⁾ and was also entered in Table 2.1. The amount of electricity used for space heat in the AQMA was estimated from the Census of

Housing (1970)⁽⁴⁾ and entered in Table 2.1; the accuracy of that data is adequate for this purpose.

The sulfur content of oil, and sulfur and ash content of coal is given in the MEI Fuel Combustion inventory for each source. Weighted sulfur and ash contents were estimated from this data according to the Manual instructions and were entered in Table 2.3.

Emission factors were taken from AP-42.⁽¹⁰⁾ While these emission factors are usually given as a function of only fuel and customer category, in some cases they are also determined by the type and size of the furnace. Since the MEI gives the furnace size (in Btu/hr. heat input) for all fuel burning sources, weighted emission factors reflecting the mix of furnace type and size could be estimated. The emission factors are shown on Worksheet 2.1. Emissions were computed by multiplying fuel use by the weighted emission factors, and sulfur or ash content if necessary, and were entered in Table 7.1.

Conclusions: The most accurate method for determining emissions from fuel combustion involves estimating emissions for each individual source and then adding up the emissions to the NER source category level, rather than aggregating fuel use data first and then converting to emissions. Raw source-specific emissions data necessary for the former approach are available in the MEI system but the printouts used for this test did not contain summarized emission data in a format directly compatible with the NER fuel source categories. These printouts contained:

- . Total fuel combustion emissions for each facility, but not emissions for each fuel
- . Total emissions for each fuel, but with no information on customer category (industrial, commercial/institutional).

Summarizing MEI source-specific emission data into the NER source category format could be accomplished only by summing

Worksheet 2.1
Fuel Emission Factors

	Units	PART	SOX	CO	HC	NOX
<u>Industrial</u> ⁴						
Residual Oil	LB/1000 GAL	23	1595	4	3	60 ⁽¹⁾
Distillate Oil	LB/1000 GAL	15	1445	4	3	60 ⁽¹⁾
Natural Gas	LB/MMCF	18	0.6	17	3	190 ⁽³⁾
<u>Commercial/ Institutional</u>						
Bituminous Coal ²	LB/TON	7A	385	6	2	10
Residual Oil	LB/1000 GAL	23	1595	4	3	60 ⁽¹⁾
Distillate Oil	LB/1000 GAL	15	1445	4	3	60 ⁽¹⁾
Natural Gas	LB/MMCF	19	0.6	20	8	120
<u>Residential</u>						
Bituminous Coal	LB/TON	2A	385	10	3	6
Distillate Oil	LB/1000 GAL	10	1445	5	3	12
Natural Gas	LB/MMCF	19	0.6	20	8	80

NOTES: S: Sulfur content (e. g. 2% sulfur means S=2.0)

A: Ash content

¹No data available from MEI on firing.

²Weighted factors based on 50% of furnaces: 10-100 MBTU/HR
50% less than 10 MBTU/HR

³Weighted factors based on 25% of furnaces: 500-7500 HP
75% greater than 7500 HP
(Fuel BTU input converted to HP output at 80% effic.)

⁴Large power plant and utility size boilers are considered in section 4.

emissions for each fuel, for each facility, manually or by using a computer-processing routine. Since both of these approaches were outside the scope of the study, the alternative method described previously was used.

In order to compute emissions from aggregated fuel totals, some simplifications were made which affect the accuracy of the emission totals entered in Table 7.1. These included using weighted emission factors (reflecting the mix of furnace type and size), using weighted sulfur and ash contents, and distributing area-source fuel use to customer categories based on the point source proportions for those categories. These simplifications are not necessary if the individual source calculations recommended in Level 3 in the Manual are employed.

(2) Emission Projections

Summary: The methodology used was essentially that recommended for Level 2. Industrial, commercial/institutional, and residential growth factors were determined and the future Btu demand for those customer categories was projected. The net Btu increase between 1974 and 1980 was then computed. The fuels expected to be used to meet this additional Btu demand were determined, and were combined with the base year fuel mix to produce the fuel mix for 1980.

Approach: Level 2 procedures as given in the Manual were followed. The baseline fuel use was converted to Btu equivalents using the following Btu conversion factors appropriate for the AQMA as supplied by BAQC:

.	Residual oil	: 150,000 Btu per gallon
.	Distillate oil	: 170,000 Btu per gallon
.	Natural gas	: 1,000 Btu per cubic foot
.	Bituminous coal:	25,000,000 Btu per ton.

The base year Btu demand was entered in Table 2.6.

Growth factors used were as follows:

- . Residential: The population growth factor
- . Industrial: The growth rate for the total manufacturing sector
- . Commercial/institutional: The expected growth in employment for commercial and institutional sectors.

The growth factors were entered in Table 2.7. These were used to project the Btu demand for each customer category and the results were also entered in Table 2.7. By comparing the projected Btu demand to the base year Btu demand, the change in Btu demand for each customer category, was determined and was also added to Table 2.7. The increase in residential Btu demand was allocated to 75 percent electricity and 25 percent distillate oil in view of the fact that few new residential customers for natural gas are being accepted in the AQMA. The increases in industrial and commercial/institutional Btu demand were allocated to 80 percent oil and 20 percent natural gas. The base year residual and distillate proportions were used to distribute the fuel oil increase between residual and distillate; the base year point source and area source proportions were also used to distribute the projected fuel increases between point and area sources.

The emission factors used for computing projected emissions were the base year emission factors, weighted to reflect the mix of furnace type and size in the AQMA. The base year sulfur and ash contents were also used, with one exception: the sulfur content of residual oil was estimated to be 0.5 percent, as suggested in the trial AQMP.⁽¹⁾ Emissions for 1980 were computed by multiplying fuel use by the emission factors, and by the sulfur and ash content, if necessary, and were entered in Table 7.2.

It was assumed that the 1980 control requirements for fuel combustion would be the same as those in 1974. This was based on the fact that the only fuel combustion controls specified in the Control Factor/Mobile Source document are for power plants.⁽¹¹⁾

Conclusions: As explained previously in the conclusions to the inventory update section, the most accurate approach for estimating present or future fuel combustion emissions involves calculations on an individual source basis rather than an aggregated source basis. With respect to accuracy, the most critical aspects of projecting fuel combustion emissions include not only the forecast of the future Btu demand but also the very careful determination of the future fuel mix.

3. TRANSPORTATION

This section contains the test results for the procedures to determine present and future emissions from all transportation sources. Highway vehicles, off-highway vehicles, rail locomotives, vessels and aircraft are discussed separately.

(1) Highway Vehicles

1. Inventory Update

Summary: The Manual instructions for a Level 1 inventory update for light-duty vehicles (LDV) were followed with a few exceptions, as described below. These procedures involve computing weighted emission factors (which include the effects of the vehicle model year distribution and deterioration of control devices), determining vehicle miles traveled (VMT) from gasoline sales data, and multiplying VMT by the weighted emission factors to produce emissions.

Approach: The fraction of vehicles in use, the annual miles driven and the weighted annual travel were taken from Table A-21 of the Control Factor/Mobile Source document.⁽¹¹⁾ The test emission factors for HC (exhaust), CO, and NO_x were taken from AP-42.⁽¹⁰⁾ These emission factors reflect the effect of deterioration of control devices with vehicle age; they were calculated only for light-duty gasoline vehicles (excluding light-duty trucks and motorcycles) because emissions in the AQMA for light-duty trucks and motorcycles were assumed to be negligible compared to automobile emissions. The test emission factors for HC (evaporation) were taken from Table 3.1.2-3 of AP-42 and those for particulates and SO_x were taken from Table 3.1.2-8 of AP-42.

The test emission factors for HC (exhaust), HC (evaporation), CO, and NO_x were multiplied by the corresponding weighted annual travel for each year and the results were entered in the boxes on lines 16 through 19 of Table 3.2. The contents of boxes on each line

were added to obtain the weighted emission factors as shown in the lower right-hand corner of Table 3.2. The effect of deterioration on particulate and SO_x emissions is minor, so the test emission factors for particulates and SO_x were used as the weighted emission factors.

The weighted emission factors obtained in Table 3.2 were transferred to Table 3.4. In the absence of local data on vehicle speeds, the speed correction factors given in Chapter III of the Manual for Level 1 inventory update were used and entered in Table 3.4. The total VMT for the AQMA were estimated by multiplying the gasoline sales in gallons for LDV by an average of 13.6 miles per gallon for LDV (all average mileage factors were taken from the Manual). The result was entered in Table 3.4. This average mileage and all others used in this section are given in the Manual.

The total emissions in 1974 were obtained by multiplying the total VMT by the speed correction factors and the corresponding weighted emission factors to obtain the emissions of HC (exhaust), CO and NO_x . Emissions for HC (evaporation), particulates and SO_x were obtained by multiplying the total VMT by the corresponding weighted emission factors. The emissions of HC (exhaust) and HC (evaporation) were added to obtain the total HC emissions. The base year emissions were entered on Worksheet 3.1 and in Table 7.1.

Baseline emission estimates for heavy-duty gasoline vehicles (HDG) were obtained as the Manual suggests for Level 1. The total VMT for this class were obtained by multiplying the gasoline sales in gallons by an average of 8.4 miles per gallon. The speed correction factors used for LDV were used for HDG vehicles as well. The emission factors were taken from AP-42. Since fuel use for this class was a small fraction of that for LDV, detailed calculations to obtain weighted emission factors were considered unnecessary. Using the total VMT, the speed correction factors and the emission factors, as shown in Table 3.4, the total emissions for HDG were obtained in the same manner as those for LDV. The results were entered in Worksheet 3.1 and Table 7.1.

Worksheet 3.1
Highway Vehicle Emissions

Vehicle Class	PART	1974 Emissions, TPY			
		SOX	NOX	HC	CO
LDV	6245	1503	49,232	65,496	528,290
HDV	392	120	4,296	7,623	62,370
HDD	<u>363</u>	<u>739</u>	<u>10,302</u>	<u>1,030</u>	<u>6,181</u>
	7000	2362	63,830	74,619	596,841

Vehicle Class	PART	1980 Emissions, TPY			
		SOX	NOX	HC	CO
LDV	6894	1660	40,300	24,156	180,994
HDV	433	132	5,161	5,304	53,044
HDD	<u>411</u>	<u>897</u>	<u>12,443</u>	<u>1,250</u>	<u>7,359</u>
	7738	2689	57,904	30,710	240,397

In the case of heavy-duty diesel vehicles (HDD), the total VMT were obtained by multiplying the diesel sales in gallons by an average of 5.1 miles per gallon. The emission factors were taken from AP-42. Using the total VMT and the emission factors as shown in Table 3.4, the emissions for HDD were obtained and entered in Worksheet 3.1 and Table 7.1.

2. Emission Projections

Approach: Level 2 procedures were carried out to estimate projected highway vehicle emissions for 1980. The growth factor used was the population growth factor. The VMT for the base year and the growth factor were entered in Table 3.4. Weighted emission factors for LDV appropriate for 1980 were computed according to the Manual instructions, and another Table 3.2 was completed for the projection year. Weighted emission factors and speed correction factors (the same as the base year) were entered in Table 3.4. These data were used to compute projected emissions which were entered on Worksheet 3.1 and Table 7.2.

Conclusions: The accuracy of both the inventory update and emission projection could be improved by using vehicle age distribution and weighted annual travel for automobiles in the Baltimore AQMA rather than the average national data taken from the Control Factor/Mobile Source document. Detailed forecasts for vehicle travel in 1980 in the AQMA would also improve the accuracy of the projections.

(2) Off-Highway Vehicles

1. Inventory Update

The three principal off-highway vehicle categories in the AQMA are gasoline and diesel tractors and diesel construction equipment. Fuel-use data by county are

tabulated by the BAQC for these three categories and are estimated based on tractor registrations and construction sector employment as described in all levels of Chapter III. Fuel-use data were entered in Table 3. 1. The following emission factors were supplied by BAQC:

<u>Pollutant</u>	<u>Units</u>	<u>Tractors (Gasoline)</u>	<u>Tractors and Construction Equipment (Diesel)</u>
Part.	lb/1,000 gal.	12	13
SO _x	lb/1,000 gal.	4.4	27
NO _x	lb/1,000 gal.	173.9	370
HC	lb/1,000 gal.	466.3	37
CO	lb/1,000 gal.	2500	225

Fuel use data were multiplied by the emission factors and the results were then entered in Table 7. 1.

2. Emission Projections

The approach used follows the Level 1 procedures. The growth factor used was that for agricultural activity computed at the beginning of this chapter. That growth factor, 1.33, was entered in Table 3. 1. The industrial growth factor (1.08), was used to approximate growth for the construction sector, and was also entered in Table 3. 1. Emissions were calculated using the base year emissions factors given above and the results were then entered in Table 7. 2.

(3) Rail Locomotives

1. Inventory Update

Summary: The procedures for all levels are identical. Since regional railroad statistics are usually not tabulated below the state level, diesel fuel consumption

by locomotives for the state was determined, and the share of fuel for the AQMA was calculated.

Approach: The names of railroads operating in Maryland, total locomotive-miles for each of these railroads, and the percentage of total miles traveled in Maryland by each railroad were determined from two publications of the Association of American Railroads (AAR), "Railroad Mileage by State" (12) and "Operating and Traffic Statistics." (13) These data were added to produce total locomotive mileage in the state. The average nationwide fuel consumption rate for locomotives was computed using the total nationwide locomotive mileage and fuel consumption from "Statistics of Railroads of Class 1," (14) published by the AAR. The amount of fuel used in Maryland was computed by dividing locomotive miles in the state by the average miles per gallon. The share of fuel for the AQMA was based on the AQMA's share of the state population and was entered in Table 3.1. These calculations are shown on Worksheet 3.2. Emissions were calculated using the emission factors in AP-42 and were entered in Table 7.1.

2. Emission Projections

The difference between the levels given in the Manual reflects the difference in effort required to identify and evaluate alternative sources for projection data. Publications of the AAR consulted for the inventory update are typical of the data sources recommended for Level 1; these publications indicated that the growth in fuel consumption from 1970 to 1973 was 2.8 percent per year. The assumption that the same rate of growth will occur in the near future yields a six-year growth factor (1974-1980) of 1.17. This growth factor and the projected fuel use were entered in Table 3.1; projected emissions were computed using the emission factors in AP-42 and were entered in Table 7.2.

Worksheet 3.2
Rail Locomotive Fuel Consumption

	Locomotive - Miles	% in State	Locomotive- Miles in State
B&O	52,449,588	5.7	2,492,477
Norfolk & Western	88,248,268	0.2	176,496
Penn Central	191,039,900	2.3	4,393,920
Western Md.	5,225,330	33.8	1,766,162
		Total	9,329,055

Total Locomotive Miles (U.S.) 1,680,170,384 MILES

Total Fuel Consumed (U.S.) 4,140,969,105 GAL

Avg. miles per gallon = 0.406

Gallons consumed in state = 9,329,055 / 0.406

= 22,977,967 GAL

= 22,978 MGAL

AQMA population/state population = 0.528

Gallons consumed in AQMA = 22,978 x 0.528

= 12,132 MGAL

(4) Vessels

1. Inventory Update

The instructions for all three levels are identical, and involve determining the fuel use for the vessel categories in Table 3.1. Fuel information was not directly available from the data supplied by the BAQC, but net emissions from vessels were given.⁽⁹⁾ Emission data by county was aggregated to the NER format as given in Table 3.1 and was entered on Worksheet 3.3 and Table 7.1.

2. Emission Projection

The growth factors used for vessels were as follows:

- . Commercial vessels (diesel and residual oil): the growth in employment for the transportation sector
- . Recreational vessels (gasoline): the population growth factor.

These growth factors are given in Worksheet 3.3. Since vessel emissions are not a major source of pollution in the Baltimore AQMA, the more time-consuming technique of interviewing port authority officials and reviewing various sources for projection information as suggested in the Manual were not employed. Base year emissions were multiplied by the growth factors and entered in Table 7.2. In computing future vessel emissions directly by multiplying base year emissions by a growth factor, it was assumed that the emission factors for 1980 would not differ from present emission factors. It was also assumed that the ratio of inport to underway fuel consumption and the ratio of diesel- to residual-fueled vessels would remain constant.

Worksheet 3.3
Vessel Emissions (1974), TPY

	PART	SOX	NOX	HC	CO
DIESEL In port	5	13	15	10	14
Underway	<u>59</u>	<u>44</u>	<u>41</u>	<u>26</u>	<u>35</u>
Total	64	57	56	36	49
RESIDUAL In port	121	3897	1416	57	69
Underway	<u>42</u>	<u>1448</u>	<u>473</u>	<u>21</u>	<u>0</u>
Total	163	5327	1889	78	69
GASOLINE (Outboard)	0	20	21	3006	10672
COAL	0	0	0	0	0

(5) Aircraft

1. Inventory Update

The activity index used to compute aircraft emissions is the number of landing and takeoff cycles (LTO). The instructions for all three levels are virtually identical, and include a number of suggested sources for LTO data. Baltimore-Washington International Airport is the single major commercial airport in the AQMA. The only aircraft activity data collected for the inventory update were for this airport, since emissions from other civil or military airports are comparatively negligible.

LTO data by aircraft type were obtained from "Airport Activity Statistics" (AAS), ⁽¹⁵⁾ an annual publication compiled jointly by the CAB and DOT. AP-42⁽¹⁰⁾ and AAS were consulted to determine the relationship between aircraft types (e.g., B-747, L-1011, DC-10) and each aircraft class as given in Table 3.5 (e.g., jumbo jet). Since emission factors in AP-42 are given in terms of lb/engine/LTO for each class, and types of aircraft within a class have varying engine configurations, it was necessary to compute engine landing/takeoff cycles (ELTO) for each class by multiplying LTO for each type by the number of engines in that type of aircraft, and adding the results to produce the total ELTO cycles for the class. This was done on Worksheet 3.4, and the aggregated ELTO data were entered on Table 3.5. Since data for military or commercial activity were not collected, those lines in Table 3.5 were left blank. Emission factors were taken from AP-42 and 1974 emissions were computed and entered in Table 7.1.

2. Emission Projections

Level 3 specifies a growth factor to be computed for each aircraft type. This more detailed approach was not followed because of the small relative contribution of aircraft emissions. Level 2 procedures, for which one growth factor reflecting the change in commercial

Worksheet 3.4
Aircraft Activity and Emissions
(1974)

Class/Type	LTO	Engines	ELTO	PART	SOX	NOX	HC	CO
Jumbo Jet								
B747	163	4	652					
L-1011	13	3	39					
DC-10	2	3	6					
	(emission factors)			(1.3)	(1.82)	(31.4)	(12.2)	(46.8)
Total			697	7,861	1,269	21,886	2,503	32,620
Long Range Jet								
B707	3692	4	14,768					
CV880	1812	4	7,248					
DC-8	3235	4	12,940					
	(emission factors)			(1.21)	(1.56)	(7.9)	(41.2)	(47.4)
Total			34,956	42,297	54,531	276,152	1,440,187	1,656,914
Med. Range Jet								
B727	12,187	3	36,561					
BAC-111	4,962	2	9,924					
DC-9	8,658	2	17,316					
B737	1,291	2	2,582					
	(emission factors)			(0.41)	(1.01)	(10.2)	(4.9)	(17)
Total			66,383	27,217	67,047	677,107	325,277	1,128,511
TurboProp								
CV580	2,696	2	5,392					
L-100	2	4	8					
L-188	3	2	12					
YS-11	702	2	404					
FL-227	4	2	8					
	(emission factors)			(1.1)	(0.4)	(2.5)	(2.9)	(6.6)
Total			6824	7,506	2,730	19,790	17,97	45,038
Total (LB/YR)				84,881	125,577	992,205	1,793,757	2,863,083
Total (TONS/YR)				42.4	62.8	496.1	896.9	1431.5

aircraft activity is required, were followed instead. This is equivalent to assuming the mix of aircraft types will remain static.

"Terminal Area Forecast, 1975-1985,"⁽¹⁶⁾ a publication of DOT, was consulted to determine the growth factor; the growth factor and projected ELTO cycles for 1980 were entered in Table 3.5. Note that the data in Table 3.5 are the number of engine landing-takeoff cycles (ELTO) since emission factors are defined on this basis. Emissions were computed using the emission factors in AP-42 and were entered in Table 7.2.

4. ELECTRIC GENERATION

This section contains the test results for the procedures to determine present and future emissions from stationary fuel combustion to generate electricity. All other stationary fuel combustion sources are considered in Section 2.

(1) Inventory Update

Summary: Current fuel use data and net emissions were available from the MEI; these data were sorted and accumulated to conform to the NEDS fuel data format.

Approach: Annual fuel consumption and net annual emissions are given in the MEI Fuel Combustion Inventory for each equipment unit at each facility. Fuel use for all facilities by fuel type and sulfur content were summed on Worksheet 4.1. This produced data for the following categories:

- . Residual oil (1% sulfur)
- . Residual oil (0.8% sulfur)
- . Distillate oil (0.3% sulfur)
- . Distillate oil (0.2% sulfur)
- . Bituminous coal
- . Natural gas.

Total fuel use for distillate and residual oil were determined, and fuel use was then entered in Table 4.1. Net emissions from the MEI for each of these six fuel categories were entered on Worksheet 4.1 and net emissions for the four NEDS fuel categories were entered in Table 7.1.

(2) Emission Projections

Summary: The Level 1 projection methodology involves projecting the amount of electricity to be generated and then determining the amount of fuels which will be burned to generate that electricity. Levels 2 and 3 specify determining directly the quantities of fuels which will be burned at each plant. The plant-specific approach is more accurate because changes in

Worksheet 4.1
Electric Generation Emissions

(1974) TPY

	Amount	%S	%A	PART	NOX	SOX	HC	10 ¹² BTU
Residual	278,500	1.0		576	13,548	20,666	149	
Residual	289,600	0.8		685	15,099	19,806	464	
Residual	658,100	(TOT)		1261	28,697	40,472	613	84.6
Distillate	26,113	0.2		383	4,751	785	40	
Distillate	18,692	0.3		130	1,689	840	18	
Distillate	44,825	(TOT)		513	6440	1625	58	6.2
Bit. Coal	749,240	1.0	8	1222	6716	14,235	112	19.5
Nat. Gas	4,813	-		151	830	49	3	4.8
Total				3147	42,683	56,318	786	115.2

Projected Emissions (1980)
(TPY)

Fuel	Growth Factor	%S ⁽¹⁾	ΔS ⁽²⁾	PART	NOX	SOX	HC
Residual	0.496	1.0	0.5	286	6744	5125	74
Residual	0.496	0.8	0.625	339	7489	6140	230
Residual	0.496	(TOT)		625	14233	11265	304
Distillate	0.496	0.2		190	2356	389	20
Distillate	0.496	0.3		64	838	416	9
Distillate	0.496	(TOT)		254	3194	805	29
Bit. Coal	0.496	1.0		606	3331	7060	55
Nat. Gas	0.496			75	412	24	1
Total				1560	21,170	19,154	389

(1) Base year sulfur content

(2) Change in sulfur content

plant-specific emission control can be included. Neither of these two approaches were followed for two reasons:

- . Plant-specific projection data were not available, but forecasts for the total fuel input demand in Btu's were available
- . The MEI does not include point or plant specific emission control data explicitly.

The general approach taken was to determine an overall growth factor for fossil fuel power generation, and to use this growth factor to project net emissions to 1980.

Approach: The available forecast data included the following:

- . Growth projection data given in terms of the future fuel input demand (Btu equivalents)
- . Future control data, including the maximum allowable sulfur content and control efficiencies required by Federal New Source Performance Standards (NSPS).

New source performance standards for power plants given in the Control Factor/Mobile Source document indicate that the regulations are expected to become effective in 1975. Thus all new equipment installed between 1975 and 1980 would be governed by these regulations. However, because equipment-specific control information was not available in the MEI, the effect of these NSPS could not be determined. It was assumed for purposes of this test that the impact of standards governing new or retrofit equipment installed between 1975 and 1980 would be minor. This assumption is supported by the fact that much of the equipment presently operational is controlled to some extent, and that since the Btu input requirements will decrease by half during that time, little new equipment will probably be installed anyway. This approach is equivalent to assuming that new equipment would have the same emission control as existing equipment.

Fuel use for 1974, as given on Worksheet 4.1, was converted to Btu equivalents and added to produce the 1974 fuel Btu demand, (115×10^{12} Btu) also shown on Worksheet 4.1. The

trial AQMP indicates that the electricity demand in the region is expected to continue to increase, but the fossil fuel demand decreases until 1978 and then starts to increase again. This decrease is due to the addition of nuclear generating capacity. The estimated fossil fuel Btu demand for 1980 is 57×10^{12} Btu, and the growth factor is, therefore, $57/115$ or 0.496 .

Projected emissions for all pollutants except SO_x from residual oil were calculated by multiplying 1974 net emissions for each fuel by the growth factor. SO_x emissions are affected by restrictions on the sulfur content of fuel oil expected to become effective in 1975 as given in the trial AQMP. (1) The maximum sulfur content of residual oil will be 0.5 percent and of distillate oil will be 0.3 percent. Almost all of the distillate oil used in 1974 was 0.3 percent sulfur or less, so distillate oil emissions will not be affected by this restriction. Most residual oil used in 1974 exceeded 0.5 percent, however. Thus, SO_x emissions for residual oil were computed by multiplying 1974 emissions by the growth factor and by a factor reflecting the change in sulfur content. This factor is 0.5 (change from 1 percent to 0.5 percent) or 0.625 (change from 0.8 percent to 0.5 percent). Projected emissions for the six fuel categories are shown on Worksheet 4.1, and were aggregated to the NEDS fuel categories and entered in Table 7.2.

Conclusions: The most accurate projection method, as stated before, involves projection on a plant or equipment basis. This approach would include consideration of planned conversions to different fuels and the installation of new generating facilities. A new 600 MW plant in the AQMA is expected to become operational in 1978. The fuel demand for 1980 reflects the impact of the new plant but not fuel information, emission control and operating characteristics specific to that facility.

5. INCINERATION

This section contains the test results for the procedures to determine present and future emissions from incineration of solid waste.

(1) Inventory Update

Summary: MEI data were converted and aggregated to NER format.

Approach: Data from the MEI incineration inventory summarized by county were aggregated to produce net annual emissions for the AQMA from solid waste disposal. Tonnage burned per year was not directly available, so Table 5.1 could not be completed. Emission data are shown on Worksheet 5.1. Additional data supplied by the BAQC⁽⁹⁾ indicated that incineration is the only method of disposal presently used in any of the jurisdictions of the AQMA, although other methods (principally open burning and coal refuse incineration) are used elsewhere in the state. Emissions were entered in Table 7.1.

(2) Emission Projections

It is quite likely that incineration emissions in the AQMA will not follow demographic or industrial growth indicators because of future restrictions on incinerator operation. Incineration contributes only slightly to the total emissions of the AQMA, therefore little effort was spent attempting to quantify future regulations concerning burning of solid waste. It was assumed that there would be no increase in emissions from this source category, so net emissions for 1980, equal to those for 1974, were entered in Table 7.2.

Worksheet 5.1
Emissions from Incineration
1974 (TPY)

Source	PART	NOX	CO	SOX	HC
Industrial	28	63	63	4	3
Commercial Institutional	2578	250	279	336	193
Residential	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>
	2606	314	343	340	196

NOTE: 1. Govt incinerators included in commercial institutional.
2. Point source emissions only
3. Unclassified sources included in commercial-institutional category.

6. MISCELLANEOUS AREA SOURCES

This final section contains the test results for the procedures to determine present and future emissions from miscellaneous area sources not considered in other sections.

(1) Inventory Update

Annual retail gasoline sales and an estimate of annual solvent use in the AQMA were included in the data supplied by BAQC.⁽⁹⁾ The solvent estimate was based on a factor of 2 lb/capita/year. These data were entered in Table 6.1. The HC emission factors suggested by BAQC were 10.4 lb/1,000 gallons (filling service station tanks) and 11.67 lb/1,000 gallons (filling automobile tanks) for gasoline handling, and 305 lb/ton for solvent use. The HC emissions were entered in Table 7.1. No other emissions from miscellaneous area sources were included in this preliminary test analysis.

(2) Emission Projections

Level 3 procedures were followed. Future solvent use was estimated using the population growth factor (1.10) and was entered in Table 6.1. As suggested in Level 3, the growth factor for automobile travel (1.10) computed previously was used to forecast gasoline sales, since vehicle travel and gasoline sales have historically been closely related (though for a variety of reasons they may not be so in the future). Future gasoline sales were also entered in Table 6.1. Projected emissions were computed using the same emission factors as were used in the inventory update section and the results were entered in Table 7.2.

* * * * *

The discussion and analysis presented in the preceding sections are intended to illustrate how the procedures given in the Manual can be applied using actual data for an AQMA. When data constraints

made strict adherence to the specified procedure infeasible, alternative approaches were used and described. This illustrates the flexibility which should characterize the use of the Manual in practice.

The results for the Baltimore AQMA which are presented here are for illustrative purposes only, and do not represent a full emissions projection for the planning area. Many assumptions which require modification and omissions resulting from the limited scope of this test effort limit the validity of the actual results, and a much more thorough study is recommended before the maintenance plan is finalized. This preliminary test served its primary purpose well in that it identified areas in the Manual instructions requiring clarification and it confirmed the applicability of the December 12, 1974, version.

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- (5) Regional Planning Council, Baltimore, Maryland, various issues of the Economic Review, a publication containing current and future trends and forecasts for the manufacturing and retail industries, population, housing and other economic parameters.
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- (12) Association of American Railroads, Economics and Finance Department, Railroad Mileage by States as of December 1971, Washington, D. C., December 1972.
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- (14) Association of American Railroads, Statistics of Railroads of Class I in the United States for the Years 1963 to 1973, Washington, D. C., August 1974.
- (15) U. S. Department of Transportation, Federal Aviation Administration, and the U. S. Civil Aeronautics board, Aircraft Activity Statistics of Certified Route Air Carriers (12 month period ended December 31, 1973)
- (16) U. S. Department of Transportation, Federal Aviation Administration, Terminal Area Forecast 1975-1985, July 1973.

Table 1.1
Baseline Emissions, Growth Factors and Controls
(TONS PER YEAR)

NEDS PROCESS CATEGORY	NEDS DATA YR _____						BASELINE YR 1974						GROWTH FACTOR	CONTROLS (1 EQUIVALENT CONTROL EFFICIENCY)					
	PART	SOX	NOX	HC	CO	1	PART	SOX	NOX	HC	CO*	PART		SOX	NOX	HC	CO		
COLUMN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
CHEMICAL MANUFACTURING							1303	6308	985	3286	3	1.29							
FOOD/AGRICULTURE							106	237	237	138	0	1.03							
PRIMARY METALS							12107	23485	3751	11273	510	0.99							
SECONDARY METALS																			
MINERAL PRODUCTS							2200	324	503	116	14	1.23							
PETROLEUM							47	217	24	57	0	1.4							
WOOD PRODUCTS							6	0	0	1795	0	1.22							
EVAPORATION							12	0	25	4917	0	1.08							
METAL FABRICATION							116	137	121	14422	0	1.03							
LEATHER																			
TEXTILE																			
INPROCESS FUEL																			
OTHER							5	28	18	6829	0	1.23							

BASELINE CALCULATION LEVEL _____, METHOD _____
PROJECTION CALCULATION LEVEL 1, METHOD 1
DATA SOURCES _____

* INCOMPLETE HEI DATA

PROJECTION YEAR 1981

Table 2.1
Baseline County Fuel Use
(External Combustion Unless Noted Otherwise)

UNITS	MAJOR FUELS										MINOR FUELS										ELEC- TRIC ITY						
	COAL			OIL				NATURAL GAS			PROCESS GAS																
RESIDENTIAL	AREA	33.7	10	4	21	78	100	24	30	10		NATURAL GAS (INTERNAL)*												184*	KWH		
	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA	POINT	AREA		Y10 ⁵	
COMMERCIAL/ INSTITUTIONAL	POINT																										
INDUSTRIAL	POINT																										
SOURCE																											

CALCULATION LEVEL 2
DATA SOURCES _____

*ALL INTERNAL COMBUSTION REFERS TO STATIONARY SOURCES ONLY

**ESTIMATED FROM CENSUS OF HOUSING

Table 2.1

Table 2.2
Sulfur and Ash Content of Coal and Heating Oil (Projections)

SOURCE	PROJECTION YEAR	PERCENT SULFUR*					PERCENT ASH*		
		ANTHRACITE COAL	BITUMINOUS COAL	LIGNITE COAL	RESIDUAL OIL	DISTILLATE OIL	ANTHRACITE COAL	BITUMINOUS COAL	LIGNITE COAL
INDUSTRIAL	YR: 1980				0.5	0.3			
	YR:								
	YR:								
COMMERCIAL/ INSTITUTIONAL	YR: 1980		2.0		0.5	0.3		8	
	YR:								
	YR:								
RESIDENTIAL	YR: 1980		2.0			0.3		8	
	YR:								
	YR:								
ELECTRICITY GENERATION	YR: 1980		1.0		0.5	2.3		8	
	YR:								
	YR:								

CALCULATION LEVEL 2
DATA SOURCES _____

*SULFUR AND ASH CONTENT ARE GIVEN PER
UNIT WEIGHT FOR COAL, PER UNIT VOLUME FOR OIL

Table 2.3
Sulfur and Ash Content of Coal and Heating Oil

SOURCE	PERCENT SULFUR*					PERCENT ASH*		
	ANTHRACITE COAL	BITUMINOUS COAL	LIGNITE COAL	RESIDUAL OIL	DISTILLATE OIL	ANTHRACITE COAL	BITUMINOUS COAL	LIGNITE COAL
INDUSTRIAL				0.8	0.3			
COMMERCIAL/ INSTITUTIONAL		2.0		0.8	0.3		8	
RESIDENTIAL		2.0					8	
ELECTRICITY GENERATION		1.0		0.8- 1.0	0.2- 0.3		8	

DATA SOURCES: _____

BASE YEAR: 1974

*SULFUR AND ASH CONTENT ARE GIVEN PER UNIT
WEIGHT FOR COAL, PER UNIT VOLUME FOR OIL

Table 2.3

Table 2.6
Baseline County Fuel Use (Btu Equivalents)
(External Combustion Unless Noted Otherwise)

ALL DATA : 10¹² BTU

SOURCE	MAJOR FUELS										MINOR FUELS										ELEC- TRIC ITY	10 ¹² BTU
	COAL			OIL				NATURAL GAS	NATURAL GAS (INTERNAL)*	PROCESS GAS	LPG	COKE	WOOD	BAGASSE	DIESEL (INTERNAL)*	GASOLINE (INTERNAL)*	ENGINE TESTING (INTERNAL)*	OTHER	OTHER (INTERNAL)*			
	ANTHRACITE	BITUMINOUS	LIGNITE	RESIDUAL	DISTILLATE	DISTILLATE (INTERNAL)*																
INDUSTRIAL	POINT	0	0	0	15	42		10													0	44.16
	AREA	0	0	0	6.6	3.36		5														
COMMERCIAL INSTITUTIONAL	POINT	0	.1	0	3.15	10.92		21													0	64.82
	AREA	0	.25	0	5.4	14		10														
RESIDENTIAL	AREA	0	.825	0	0	37.58		33.7													.583	72.625

CALCULATION LEVEL 2
DATA SOURCES _____

*ALL INTERNAL COMBUSTION REFERS TO STATIONARY SOURCES ONLY

Table 2.7
Fuel Combustion Growth Factor
and Projected Btu Demand

SOURCE	GROWTH FACTOR YR ~~1980~~	PROJECTED BTU DEMAND	Δ BTU
RESIDENTIAL	1.089	79.09	+6.46
COMMERCIAL/ INSTITUTIONAL	1.106	71.69	+6.87
INDUSTRIAL	1.08	47.69	+3.53

CALCULATION LEVEL 2

DATA SOURCES _____

Table 2.7

Table 2.8
Projected County Fuel Use
(External Combustion Unless Noted Otherwise)

SOURCE	MAJOR FUELS										MINOR FUELS										ELEC- TRIC- ITY
	COAL			OIL			NATURAL GAS	NATURAL GAS (INTERNAL)*	PROCESS GAS	LPG	COKE	WOOD	BAGASSE	DIESEL (INTERNAL)*	GASOLINE (INTERNAL)*	ENGINE TESTING (INTERNAL)*	OTHER	OTHER (INTERNAL)*			
	ANTHRACITE	BITUMINOUS	LIGNITE	RESIDUAL	DISTILLATE	DISTILLATE (INTERNAL)*															
INDUSTRIAL	POINT	0		110	324		10.3												**		
	AREA	0		48.3	25.9		5.1												**		
COMMERCIAL/ INSTITUTIONAL	POINT	4		24.2	88.7		21.9												**		
	AREA	10		41.6	113.8		10.4												**		
RESIDENTIAL	POINT	33.7		0	272.5		33												**		
	AREA																		**		
UNITS		1000 TONS			1000,000 GALLONS			10 ⁶ CU FT		1000 GAL	TONS			1000 GALLONS					KWH X 1		

CALCULATION LEVEL _____
DATA SOURCES _____

*ALL INTERNAL COMBUSTION REFERS TO STATIONARY SOURCES ONLY

** ACTUAL PROJECTED ELECTRICAL USAGE IS NOT
NEEDED TO CALCULATE EMISSIONS

Table 3.1
 Transportation Activity (Off-Highway Vehicles, Rail and Vessels)
 Baseline and Projections

SOURCE	FUEL	UNITS	LINE	BASELINE		PROJECTIONS					
				YR 74	YR 80	YR 80		YR 85		YR 90	
				AMOUNT	GROWTH FACTOR	AMOUNT	GROWTH FACTOR	AMOUNT	GROWTH FACTOR	AMOUNT	GROWTH FACTOR
OFF-HIGHWAY VEHICLES	TRACTORS	1000 GAL	1	3985	1.33	5300					
	OTHER	1000 GAL	2	0		0					
	TRACTORS	1000 GAL	3	2325	1.33	3092					
	CONSTRUCTION	1000 GAL	4	66305	1.08	71609					
	OTHER	1000 GAL	5	0		0					
RAIL	DIESEL	1000 GAL	6	12132	1.17	14194					
VESSELS	DIESEL	1000 GAL	7	(1)	1.19	(1)					
	RESIDUAL OIL	1000 GAL	8	(1)	1.19	(1)					
	COAL	TONS	9	0		0					
	GASOLINE	1000 GAL	10	(1)	1.10	(1)					

(1) SEE WORKSHEET 3.3

BASLINE CALCULATION LEVEL _____

PROJECTION CALCULATION LEVEL 1 (ALL SOURCES)

DATA SOURCES _____

Table 3.1

Table 3.2
Weighted Emission Factors for Light-Duty Gasoline Vehicles (Base Year or Projections)

VEHICLE AGE, YEARS (i)	LINE	1	2	3	4	5	6	7	8	9	10	11 OR MORE
VEHICLE MODEL YEAR	2	74	73	72	71	70	69	68	67	66	65	64
FRACTION OF VEHICLES IN USE (f _i)	3	.097	.123	.123	.127	.093	.093	.088	.072	.056	.037	.059
ANNUAL MILES DRIVEN (n _i)	4	9900	12900	11750	10650	9350	9225	8675	8075	7900	7225	5859
f _i n _i (line 3 x line 4)	5	960	2231	1445	1139	868	857	763	610	442	281	318
WEIGHTED ANNUAL TRAVEL	6	.097	.225	.145	.115	.089	.086	.077	.061	.045	.028	.031
DETERIORATION FACTOR	7											
HC (EXH)	8											
CO	9											
NOX	10											
HC (EXH)	11	3.2	3.5	3.8	4.7	5.8	5.8	7.4	8.9	8.9	8.9	8.9
HC (EVAP)	12	0.2	0.2	0.2	0.5	3.0	3.0	3.0	3.8	3.8	3.8	3.8
CO	13	39.0	39.0	41.0	56.0	58.5	68.4	70.6	95.0	95.0	95.0	95.0
NOX	14	3.1	3.3	4.55	4.30	4.35	5.08	4.32	3.34	3.34	3.34	3.34
PART	15	.54										
SOX	16											
HC (EXH)	17	0.31	0.78	0.55	0.59	0.57	0.57	0.57	0.55	0.4	0.25	0.27
HC (EVAP)	18	0.097	0.095	0.029	0.057	0.27	0.26	0.23	0.23	0.17	0.106	0.11
CO	19	3.78	8.77	5.94	6.44	5.2	5.88	5.43	5.79	4.27	2.66	2.94
NOX	20	0.30	0.74	0.66	0.49	0.38	0.43	0.33	0.20	0.15	0.09	0.10
PART	21											
SOX												
WEIGHTED EMISSION FACTOR (g/mi)												
HC (EXH)												5.23
HC (EVAP)												1.52
CO												57.10
NOX												3.87
PART												0.54
SOX												0.13

SUM FOR LINE 5
(Σ f_i n_i)

HC (EXH)
HC (EVAP)
CO
NOX
PART
SOX

WEIGHTED
EMISSION
FACTOR
(g/mi)

YEAR 1974
CALCULATION LEVEL 2
DATA SOURCES

Table 3.4
Highway Vehicle Transportation Activity,
Baseline and Projections

VEHICLE TYPE AND FUEL	LIGHT DUTY VEHICLES				HEAVY DUTY GASOLINE VEHICLES	HEAVY DUTY DIESEL VEHICLES
	LIGHT DUTY GASOLINE VEHICLES*	LIGHT DUTY TRUCKS	MOTORCYCLES			
COLUMN	1	2	3		4	5
BASLINE ACTIVITY	YR 1974					
(VMT)						
GROWTH FACTOR (PROJECTION YEAR)	104.8 x 10 ⁸				4.2 x 10 ⁸	3.03 x 10 ⁸
YR						
SPEED COR- RECTION FACTORS						
HC (EXH)	0.8				0.8	
CO	0.8				0.8	
NOX	1.1				1.1	
HC (EXH)	5.23				16.5	3.9
HC (EVAP)	1.52					
CO	57.10				135	20.4
NOX	3.87				9.3	34
PART	0.54				0.85	1.2
SOX	0.13				0.26	2.4

BASLINE CALCULATION LEVEL _____
PROJECTION CALCULATION LEVEL _____
DATA SOURCES _____

*IF THREE VEHICLE CLASSIFICATION IS USED, AND ALL LIGHT DUTY VEHICLES ARE CONSIDERED IN AGGREGATE, USE THIS COLUMN FOR LIGHT DUTY VEHICLE DATA

**USE LOW MILEAGE TEST EMISSION FACTORS IF ADJUSTMENT FOR VEHICLE AGE, MODEL YEAR AND CONTROL DETERIORATION (TABLE 3.2) ARE NOT MADE.

Table 3.4
Highway Vehicle Transportation Activity,
Baseline and Projections

VEHICLE TYPE AND FUEL	LIGHT DUTY VEHICLES				HEAVY DUTY GASOLINE VEHICLES	HEAVY DUTY DIESEL VEHICLES
	LIGHT DUTY GASOLINE VEHICLES*	LIGHT DUTY TRUCKS	MOTORCYCLES			
COLUMN	1	2	3		4	5
BASLINE YR <u>1974</u> ACTIVITY (VMT)	104.8×10^8				4.2×10^8	3.03×10^8
GROWTH FACTOR (PROJECTION YEAR)	1.104				1.104	1.104
SPEED COR- RECTION FACTORS	HC (EXH)	0.8			0.8	
	CO	0.8			0.8	
	NOX	1.1			1.1	
WEIGHTED EMISSION FACTORS** (g/mi)	HC (EXH)	1.99			1.3	3.4
	HC (EVAP)	0.3				
	CO	17.72			130	20.4
	NOX	2.87			9.2	34
	PART	0.54			0.85	1.2
	SOX	0.13			0.26	2.4

BASELINE CALCULATION LEVEL _____
PROJECTION CALCULATION LEVEL 2
DATA SOURCES _____

*IF THREE VEHICLE CLASSIFICATION IS USED, AND ALL LIGHT DUTY VEHICLES ARE CONSIDERED IN AGGREGATE, USE THIS COLUMN FOR LIGHT DUTY VEHICLE DATA

**USE LOW MILEAGE TEST EMISSION FACTORS IF ADJUSTMENT FOR VEHICLE AGE, MODEL YEAR AND CONTROL DETERIORATION (TABLE 3.2) ARE NOT MADE.

Table 3.4

Table 3.5
Aircraft Activity, Baseline and Projections

AIRCRAFT	TYPE	BASELINE LTO CYCLES	GROWTH FACTOR	PROJECTED LTO CYCLES	GROWTH FACTOR	PROJECTED LTO CYCLES	GROWTH FACTOR	PROJECTED LTO CYCLES
COLUMN		1974		1980				
YEAR		1	2	3	4	5	6	7
JUNBO JET	COMMERCIAL	697	1.19	829				
LONG RANGE JET	COMMERCIAL	34956	1.19	41598				
MEDIUM RANGE JET	COMMERCIAL	66383	1.19	78996				
AIR CARRIER - TURBOPROP	COMMERCIAL	6824	1.19	8121				
BUSINESS JET	CIVIL							
GENERAL AVIATION TURBOPROP	CIVIL							
GENERAL AVIATION PISTON	CIVIL							
PISTON TRANSPORT	CIVIL							
HELICOPTER	MILITARY							
MILITARY TURBOPROP	MILITARY							
MILITARY JET	MILITARY							
MILITARY PISTON	MILITARY							

BASELINE CALCULATION LEVEL
PROJECTION CALCULATION LEVEL 2
DATA SOURCES

Table 6.1
Activity Producing Evaporation Emissions, Baseline and Projections

SOURCE	UNITS	BASELINE		PROJECTIONS	
		YR 1974	YR 1980	YR	YR
GASOLINE	~~1000~~ GALLONS	840000	924000		
SOLVENTS	TONS	2229	2446		

Growth
Factor

1.10

1.10

BASELINE CALCULATION LEVEL _____
PROJECTION CALCULATION LEVEL 3
DATA SOURCES _____

Table 7.1
County Base Year Emissions Report

COUNTY ~~BALTIMORE~~ AQMA
YEAR 1974

SOURCE		EMISSIONS, TONS PER YEAR				
		PART	SOX	NOX	HC	CO
FUEL COMBUSTION EXTERNAL	RESIDENTIAL FUEL (AREA)	ANTHRACITE COAL				
		BITUMINOUS COAL	269	1280	101	51
		DISTILLATE OIL	1340	5788	1408	402
		RESIDUAL OIL				670
		NATURAL GAS	313	10	1320	132
		WOOD				330
		TOTAL	1922	7078	3229	585
	ELECTRIC GENERATION (POINT)	ANTHRACITE COAL				1168
		BITUMINOUS COAL	1222	14235	6716	112
		LIGNITE				
		RESIDUAL OIL	1261	40472	28697	613
		DISTILLATE OIL	513	1425	6440	58
		NATURAL GAS	151	49	830	3
		PROCESS GAS				
		COKE				
		SOLID WASTE/COAL				
		TOTAL	3147	56384	42683	786
FUEL COMBUSTION EXTERNAL	INDUSTRIAL FUEL	ANTHRACITE COAL				
		POINT				
		AREA				
		BITUMINOUS COAL				
		POINT				
		AREA				
		LIGNITE				
		POINT				
		RESIDUAL OIL	506	2778	1320	66
		AREA				88
		POINT	1190	6360	3000	150
		AREA	180	578	720	36
		DISTILLATE OIL				48
		POINT	225	648	900	45
		AREA	45	1	475	7
		NATURAL GAS	90	3	950	15
		POINT				85
		PROCESS GAS				
		AREA				
		POINT				
		COKE				
		POINT				
		WOOD				
		AREA				
		POINT				
		LIQUID PETROL GAS				
		POINT				
		BAGASSE				
		POINT				
		OTHER				
		POINT				
		TOTAL	731	3317	2515	109
		AREA	1465	7011	4890	210
		POINT				178
		TOTAL				345

Table 7.1
Continued

SOURCE		PART	SOX	NOX	HC	CO
FUEL COMBUSTION EXTERNAL (CONTINUED)	COMMERCIAL INSTITUTIONAL FUEL	AREA POINT				
	ANTHRACITE COAL	AREA POINT				
	BITUMINOUS COAL	AREA POINT	280	380	50	10
		AREA POINT	112	152	20	4
	LIGNITE	AREA POINT				
	RESIDUAL OIL	AREA POINT	414	2290	1080	54
		AREA POINT	241	1336	630	31
		AREA POINT	250	2160	3000	150
	DISTILLATE OIL	AREA POINT	585	1685	2340	117
		AREA POINT	95	3	600	40
	NATURAL GAS	AREA POINT	199	6	1260	84
	WOOD	AREA POINT				
		AREA POINT				
	LIQUID PETROL GAS	AREA POINT				
	OTHER	AREA POINT				
	TOTAL	AREA POINT	1534	4633	4730	254
		AREA POINT	1137	3179	4250	236
FUEL COMBUSTION INTERNAL	OTHER	AREA POINT				
	TOTAL EXTERNAL COMBUSTION	AREA POINT				
	ELECTRIC GENERATION					
	DISTILLATE OIL					
	NATURAL GAS					
	DIESEL					
	OTHER					
	TOTAL					
	INDUSTRIAL FUEL					
	DISTILLATE OIL					
	NATURAL GAS					
	GASOLINE					
	DIESEL					
	OTHER					
	TOTAL					
	COMMERCIAL INSTITUTIONAL FUEL					
	DIESEL					
	TOTAL					
	ENGINE TESTING AIRCRAFT					
	TOTAL INTERNAL COMBUSTION					
TOTAL FUEL COMBUSTION	AREA		4192	15228	10247	948
	POINT		5749	6571	5183	1232
						1748
						765

Table 7.1
Continued

SOURCE		PART	SOX	NOX	HC	CO
INDUSTRIAL PROCESS (POINT)	CHEMICAL MANUFACTURING	1303	6318	185	3286	3
	FOOD/AGRICULTURE	106	237	237	138	
	PRIMARY METAL	12107	29185	31751	11273	510
	SECONDARY METALS					
	MINERAL PRODUCTS	2200	324	503	116	14
	PETROLEUM INDUSTRY	47	217	24	57	
	WOOD PRODUCTS	6			1245	
	PROCESS EVAPORATION	12		25	4917	
	METAL FABRICATION	116	137	121	14427	
	LEATHER PRODUCTS					
	TEXTILE MANUFACTURING					
	INPROCESS FUEL					
	OTHER/NOT CLASSIFIED	5	28	18	6825	
	TOTAL	15702	36746	33664	42834	527
SOLID WASTE DISPOSAL	GOVERNMENT (POINT)	MUNIC. INCIN.				
		OPEN BURNING				
		OTHER				
		TOTAL				
	RESIDENTIAL (AREA)	ON-SITE INCIN.		1		1
		OPEN BURNING				
		TOTAL				
	COMMERCIAL INSTITUTIONAL	ON-SITE INCIN.				
		ERATION				
		OPEN BURNING	2578	336	193	277
		AREA				
		POINT				
		APARTMENT				
		OTHER				
		TOTAL				
	INDUSTRIAL	ON-SITE INCIN.				
		ERATION				
		OPEN BURNING	28	4	63	69
		AREA				
		POINT				
		AUTO BODY INCIN.				
		OTHER				
		TOTAL				
	TOTAL SOLID WASTE DISPOSAL	AREA				
		POINT	2606	340	196	343

Table 7.1
Continued

TRANSPORTATION (AREA)	SOURCE		PART	SOX	NOX	HC	CO
	LAND VEHICLES	GASOLINE					
		LIGHT DUTY	6245	1503	49232	65996	528290
		HEAVY DUTY	392	120	4296	7623	62320
		OFF HIGHWAY	24	9	346	929	9980
		TOTAL	6661	1632	52874	74548	595690
		DIESEL	363	739	10302	1030	6181
		HEAVY DUTY	461	958	13128	1313	7983
		OFF HIGHWAY	302	690	4077	1137	1573
		RAIL					
		TOTAL					
	AIRCRAFT	MILITARY					
		CIVIL					
		COMMERCIAL	42	63	496	897	1431
		TOTAL	42	63	496	897	1431
	VESSELS	BITUMINOUS COAL	0	0	0	0	0
		DIESEL FUEL	64	57	56	36	49
		RESIDUAL OIL	163	5327	1084	78	69
		GASOLINE	0	20	21	3006	10672
		TOTAL	227	5404	1966	3120	10790
	GAS HANDLING EVAPORATION LOSS *		0	0	0	9267	0
	TOTAL TRANSPORTATION		8056	9466	8543	91304	623588

* INCLUDES HANDLING AND STORAGE

Table 7.1
Continued

SOURCE		PART	SOX	NOX	HC	CO
MISCELLANEOUS (AREA)	SOLVENT EVAPORATION	INDUSTRIAL SOURCES (AREA)				
		DRY CLEANING	0	0	339	0
	FIRES	STRUCTURAL				
		FROST CONTROL				
		SLASH BURNING				
		WILD FOREST				
		AGRICULTURAL				
	DUST CAUSED BY HUMAN AGI- TATION OF THE AIR	UNPAVED ROADS				
		UNPAVED AIRSTRIPS				
		PAVED ROADS				
		MINERAL PROCESSING				
		TILLING ACTIVITIES				
		LOADING CRUSHED ROCK, SAND, GRAVEL				
		CONSTRUCTION				
	AIRBORNE DUST CAUSED BY NATURAL WINDS	STORAGE PILES				
		TILLED LAND				
		UNTILLED LAND				
GRAND TOTAL	AREA		12248	24714	95490	12591624184
	POINT		24257	103657	85761	442621787
	GRAND TOTAL		36505	128371	181251	136853625971

Table 7.2
Projected County Emissions Report

COUNTY **BALTIMORE** AQMA
YEAR **1980**

SOURCE		EMISSIONS TONS PER YEAR						
		PART	SOX	NOX	HC	CO		
FUEL COMBUSTION EXTERNAL	RESIDENTIAL FUEL (AREA)	ANTHRACITE COAL						
		BITUMINOUS COAL	270	1280	101	51	168	
		DISTILLATE OIL	1387	5774	1665	416	694	
		RESIDUAL OIL						
		NATURAL GAS	313	10	1320	132	330	
		WOOD						
		TOTAL	1960	7284	3086	599	1202	
		ELECTRIC GENERATION (POINT)	ANTHRACITE COAL					
			BITUMINOUS COAL	606	7060	3331	55	
			LIGNITE					
RESIDUAL OIL	625		11265	14233	304			
DISTILLATE OIL	254		805	3174	29			
NATURAL GAS	75		24	412	1			
PROCESS GAS								
COKE								
SOLID WASTE COAL								
TOTAL	1560		19154	21170	389			
FUEL COMBUSTION EXTERNAL	INDUSTRIAL FUEL	ANTHRACITE COAL						
		AREA POINT						
		BITUMINOUS COAL						
		AREA POINT						
		LIGNITE						
		AREA POINT						
		RESIDUAL OIL	555	1920	1449	72	97	
		AREA POINT	1265	4372	3300	165	220	
		DISTILLATE OIL	174	557	777	37	52	
		AREA POINT	243	700	972	47	65	
		NATURAL GAS	46	2	484	8	43	
		AREA POINT	92	3	978	15	88	
		PROCESS GAS						
		AREA POINT						
		COKE						
		AREA POINT						
		WOOD						
		AREA POINT						
		LIQUID PETROLEUM GAS						
		AREA POINT						
		NATURAL GAS						
		AREA POINT						
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		LIQUID PETROLEUM GAS						
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LIQUID PETROLEUM GAS								
AREA POINT								
NATURAL GAS								
AREA POINT								
COKE								
AREA POINT								
WOOD								

Table 7.2
Continued

SOURCE		PART	SOX	NOX	HC	CO	
FUEL COMBUSTION EXTERNAL (CONTINUED)	COMMERCIAL INSTITUTIONAL FUEL						
	ANTHRACITE COAL	AREA POINT					
	BITUMINOUS COAL	AREA POINT	280	50	5	30	
	LIGNITE	POINT	112	20	4	12	
	RESIDUAL OIL	AREA POINT	478	1248	62	83	
	DISTILLATE OIL	AREA POINT	278	726	36	24	
	NATURAL GAS	AREA POINT	853	344	171	228	
	WOOD	AREA POINT	665	266	133	177	
	LIQUID PETROL GAS	AREA POINT	99	3	624	42	
	OTHER	AREA POINT	208	7	134	88	
	TOTAL	AREA POINT	1710	4308	280	445	
	TOTAL EXTERNAL COMBUSTION		POINT	1263	472	261	432
		ELECTRIC GENERATION	AREA POINT	4465	14020	998	1839
		DISTILLATE OIL	POINT	4423	27190	877	805
		NATURAL GAS					
		DIESEL					
OTHER							
TOTAL							
INDUSTRIAL FUEL							
DISTILLATE OIL							
NATURAL GAS							
GASOLINE							
DIESEL							
OTHER							
TOTAL							
COMMERCIAL INSTITUTIONAL FUEL							
DIESEL							
TOTAL							
ENGINE TESTING							
TOTAL INTERNAL COMBUSTION							
TOTAL FUEL COMBUSTION							
TOTAL FUEL COMBUSTION		4465	14020	11132	998	1839	
		4423	27190	3141	877	805	

Table 7.2
(continued)

SOURCE		PART	SOX	NOX	HC	CO
INDUSTRIAL PROCESS (POINT)	CHEMICAL MANUFACTURING	1680	8150	1271	4237	4
	FOOD AGRICULTURE	109	244	244	142	
	PRIMARY METAL	11986	29140	31433	11160	505
	SECONDARY METALS					
	MINERAL PRODUCTS	2206	399	619	143	17
	PETROLEUM INDUSTRY	66	267	30	70	
	WOOD PRODUCTS	7				
	PROCESS EVAPORATION	13		27	2190	
	METAL FABRICATION	119	141	125	5310	
	LEATHER PRODUCTS				14860	
	TEXTILE MANUFACTURING					
	INPROCESS FUEL					
	OTHER/NOT CLASSIFIED	6	34	22	8395	
	TOTAL	16692	38425	33771	46509	526
SOLID WASTE DISPOSAL	GOVERNMENT (POINT)	MUNIC. INCIN.				
		OPEN BURNING				
		OTHER				
		TOTAL				
	RESIDENTIAL (AREA)	ON SITE INCIN.				
		OPEN BURNING				
		TOTAL				
	COMMERCIAL INSTITUTIONAL	ON SITE INCIN.				
		ERATION				
		OPEN BURNING	2528	250	193	279
		AREA				
		POINT				
		APARTMENT				
		OTHER				
		AREA				
	INDUSTRIAL	POINT				
		AREA				
		POINT				
		AREA				
		POINT				
		AREA				
		POINT				
		AREA				
		POINT				
		AREA				
	TOTAL SOLID WASTE DISPOSAL	ON SITE INCIN.				
		ERATION				
		OPEN BURNING	28	4	63	63
		AREA				
		POINT				
		AREA				
	TOTAL SOLID WASTE DISPOSAL	POINT				
		AREA				
		POINT				
		AREA				
	TOTAL SOLID WASTE DISPOSAL	POINT				
		AREA				
	TOTAL SOLID WASTE DISPOSAL	POINT	2606	340	314	196
		AREA				343

III-24

* INCLUDES HANDLING AND STORAGE

Table 7.2
Continued

SOURCE		PART	SOX	NOX	HC	CO
MISCELLANEOUS (AREA)	SOLVENT EVAPORATION	INDUSTRIAL SOURCES (AREA)				
		DRY CLEANING	0	0	339	0
	FIRES	STRUCTURAL				
		FROST CONTROL				
		SLASH BURNING				
		WILD FOREST				
		AGRICULTURAL				
	DUST CAUSED BY HUMAN AGITATION OF THE AIR	UNPAVED ROADS				
		UNPAVED AIRSTRIPS				
		PAVED ROADS				
		MINERAL PROCESSING				
		TILLING ACTIVITIES				
AIRBORNE DUST CAUSED BY NATURAL WINDS	LOADING CRUSHED ROCK, SAND, GRAVEL					
	CONSTRUCTION					
	STORAGE PILES					
	TILLED LAND					
	UNTILLED LAND					
GRAND TOTAL	AREA	13410	25124	9145	50247	273967
	POINT	23721	65955	65226	47584	1674
GRAND TOTAL		37131	91079	157171	98331	275641